Devonian Marine Invertebrate Fossils from the Port Macquarie Block, New South Wales

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Two assemblages of rugose and tabulate corals, with accessory stromatoporoids and chaetetids, are described from the Touchwood and Mile Road Formations of the Wauchope – Port Macquarie district of northeastern New South Wales. Both assemblages are derived from allochthonous limestone clasts, except that the Mile Road fauna is accompanied at the same level by branching tabulate corals occurring in the matrix, indicating probable contemporaneity. The fauna from the Touchwood Formation indicates an Early Devonian (Emsian) age. Macrofossils from the Mile Road Formation indicate a broad Middle Devonian, probably Givetian age; conodonts accompanying the coral assemblage yield a precise age in the upper part of the early Givetian *varcus* Zone. Geographic affinities of the assemblages are typically eastern Australian, so that if terranes are represented in the block, these were not remote. Stratigraphic and structural relationships of the units are discussed. The name Mile Road Formation is formally defined.

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Key words: chaetetids, conodonts, Devonian, Emsian, Givetian, Mile Road Formation, Port Macquarie Block, Rugosa, stromatoporoids, Tabulata, Touchwood Formation.

INTRODUCTION

Immediately west of Port Macquarie, some 350 km north of Sydney, Palaeozoic units of the New England Fold Belt are exposed in a series of narrow belts delimited by NNE-striking faults (Fig.1) (Leitch, 1980; Roberts et al., 1995). Stratigraphic relationships between the units and their relative ages are not clear, so indications of age are particularly important in geological interpretations of the area. The ages of these rocks have been little constrained by published biostratigraphic data, with the only firm determinations those yielded by conodonts of Middle-Late Ordovician age from chert in the structurally dismembered Watonga Formation (Och et al., 2007), earlier attributed a Silurian or Devonian age on the basis of meagre conodont and radiolarian faunas (Ishiga et al., 1988). Unpublished reports by Pickett (1985, 1991) presented evidence for the Devonian age of limestone from two other units, the Touchwood Formation (Leitch, 1980) and the Mile Road Formation (Taylor, 1984, unpublished; Roberts et al., 1995). The present article is principally based on the re-examination of material described by Pickett, augmented by additional collecting. This has led to some refinement of the initial results, tectonically valuable biogeographic information, and a new stratigraphic interpretation. A formal description of the Mile Road Formation is included as Appendix 1.

STRATIGRAPHIC UNITS

The *Mile Road Formation* has only been recognized in the southern part of the wedge of rocks bounded by the Sancrox, Cowarra and Sapling Creek faults (Fig. 1) where it comprises interbedded fossiliferous siltstone and sandstone, containing blocks of coralline limestone and silicic tuff. The rocks form a sequence at least 1500 m thick, dipping steeply

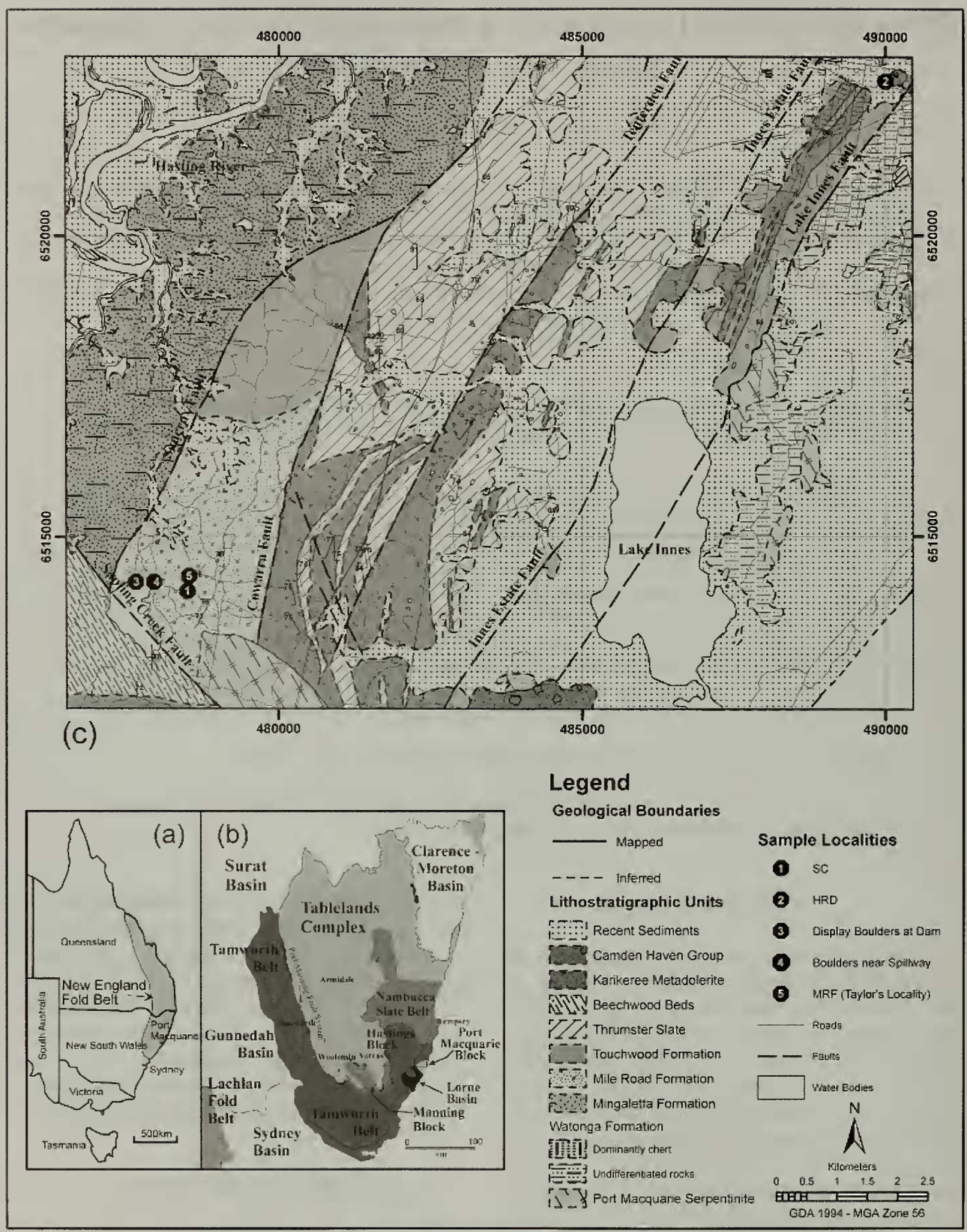


Figure 1. Geological map of Wauchope – Port Macquarie area.

mostly to the west, and younging in this direction, based on meagre data from near the intersection of Cowarra Access Road and the Mile Road (GR 478900 6514400, Grants Head 1:25 000 sheet). Strike ranges from northeast away from the Cowarra Fault to almost north close to the fault. Sandstone is volcaniclastic and of silicic, probably dacitic, provenance, with abundant detrital plagioclase and vitric and felsitic

lithic grains, and uncommon monocrystalline quartz grains. Many grains are angular and little abraded suggesting the rocks include abundant little modified ash. Finer grained rocks are of similar composition. Scattered coral, brachiopod and crinoid fossils are locally prominent in the clastic rocks some of which are extensively bioturbated (cf. Fig. 7C). Coralline limestone occurs as blocks embedded in fossiliferous sandstone and siltstone and locally (GR 478400 6514100) as weathered-out boulders up to about 1 m across that may originally have been derived from autochthonous lenses beyond the outcrop area. Silicic tuff is prominent in the lower part of the formation where it forms hard grey beds up to at least 0.25 m thick. It is of similar composition to the sandstones but distinguished by the presence of well-preserved shard structures in which the original glass has been replaced by fine-grained quartzofeldspthic aggregate. Euhedral plagioclase grains are widespread although broken angular grains are also common.

The *Touchwood Formation* is exposed between the Lake Innes and Innes Estate faults (Fig.1) from where it was described by Leitch (1980) as consisting of a sequence of siltstone, sandstone, paraconglomerate, basalt breccias and andesite at least 600 m thick. Much of the stratigraphically lower sedimentary part of the formation here is thin-bedded and consists predominantly of simply graded grey sandstone and darker horizontally laminated siltstone. Rare paraconglomerate beds, up to at least 20 m thick and the upper part of which are simply graded, contain clasts of basalt and andesite, slabs of bedded intraformational material and cobbles of coralline limestone.

Further west, between the converging Sancrox and Cowarra faults north of the Mile Road Formation, Taylor (1984) mapped thin bedded siltstone, some radiolarian-bearing, graded and massive sandstone, chert and andesitic breccia as Touchwood Formation. He considered these rocks were faulted against the Mile Road Formation, an interpretation followed by Roberts et al. (1995). The contact between the two units is unexposed and occurs in a region of very little outcrop. Although it may be a fault, on the basis of structural and younging indications in both units, we favour interpretation as a stratigraphic contact, with Touchwood overlying the Mile Road (but see below under Discussion).

Like those of the Mile Road Formation, Touchwood sandstones are volcaniclastic but differ in being of more mafic provenance. Abundant detrital components are lathwork and microlitic lithic grains and plagioclase; felsitic and vitric grains and quartz are uncommon, and calcic clinopyroxene is widespread but mostly only in small amounts.

FOSSIL LOCALITIES

The fossils described in this article come from three localities. The first (HRD) lies within the Touchwood Formation in its type section (Leitch, 1980), the material coming from a disused quarry on the eastern side of Aston Street, north of the Hibbard – Port Macquarie road (Hastings River Drive) at GR 490000 6522560 (m), Port Macquarie 1:25,000 sheet (9435-2S). The material was originally collected by Erwin Scheibner, and is supplemented by samples taken by the present authors; Leitch's (1980, p. 278) first mention of fossils is restricted to reporting rugose and tabulate corals. The second (MRF) is within the informally named "Mile Road Formation" of Taylor (1984) in a creek-bed in wooded country west of Forest Road at GR 478400 6514100 (m), Grants Head 1:25,000 sheet. The material was originally collected by Michael Taylor, and his formation name is formalised herein.

Locality MRF could not be re-located using the information supplied by Taylor, but a general search led to a third locality (SC) in the bed of Sarahs Creek south of the ford on an unnamed forestry track at GR 478500 6514100 on the Grants Head 1:250,000 sheet (9434-1N). Here the mudstones of the Mile Road Formation dip 65° to 145°, and contain abundant fragments of the branching tabulate coral *Thamnopora* over a stratigraphic interval of possibly 30 m; near the middle of this interval there are also larger blocks of limestone made up of large colonies of massive favositid and heliolitid corals, the largest with maximum dimensions of c. 700 x 450 mm. The broken fragments of *Thamnopora* which occur in the matrix indicate that the larger blocks were derived penecontemporaneously.

During the construction of Cowarra Dam a number of large blocks of allochthonous limestone were uncovered, the largest of which are now on display at the picnic area near the dam wall. The assemblages in these blocks indicate that their source is the same as that of the blocks originally collected by Taylor, but the assemblages they contain are much richer. In addition to the small assemblage originally reported by Pickett (1985) and supplemented herein, the blocks include large colonies of a large species of *Spongophyllum*, *Syringopora* sp., *Heliolites* sp., a cystiphyllid, a large solitary rugosan and *Squameofavosites* sp., as well as brachiopods. Because of the display situation, none of this material could be collected. The display boulders were obtained from a locality now covered by the dam wall at GR 477650 6514250 (Grants Head sheet), and more material near the spillway at GR 477950 6514250. All these localities within the Mile Road Formation are roughly aligned in a WNW

– ESE direction, suggesting an episode of slumping of limy material during deposition of what is probably the older part of the formation.

The environmental setting of all localities is similar, in that the fossils are allochthonous, being derived from clasts in slump deposits. At locality HRD the limestone clasts are small, the largest observed being about 35 cm in maximum dimension; some of the soft-sediment clasts in this deposit exceed a metre in maximum dimension. All the limestone and fossil clasts from the Mile Road Formation however are considerably larger, suggesting that their source lay much closer than in the case of the Touchwood Formation.

AGES OF THE OCCURRENCES

The occurrences of coralliform taxa are listed in Table 1. Those forms only identified in the field (marked with an asterisk) are not used for age determination. Detailed discussion is supplied in the Systematics section, under "Remarks" for each of the relevant taxa.

Touchwood Formation. Significant for the age of this unit are *Xystriphyllum* cf. *mitchelli minus*, known only from the mid-Emsian *perbonus-gronbergi* Zone, *Acanthophyllum* sp., whose congeners are restricted to the Emsian in eastern Australia, and *Sterictophyllum* sp., whose genus is typically Pragian. *Phillipsastrea*

Table 1. Occurrences of coral taxa in the Mile Road and Touchwood Formations.

	HRD Ashton St Quarry Touchwood Fm	**MRF Cowarra Dam Mile Road Fm**	**SC Sarahs Creek Mile Road Fm**
Chaetetes sp.	x		
Coenostroma sp.	x		
Endophyllum cf. *columna* Hill		x	
Acanthophyllum sp	x		
Xystriphyllum cf. *mitchelli minus* Parker	x		
Phillipsastrea cf. *maculosa* Hill	x		
Sterictophyllum sp.	x		
Favosites salebrosa Etheridge fil.			x
Pachyfavosites sp.	x		
Squameofavosites squamuliferus Etheridge fil.	x		
Cladopora sp.	x		
Thamnopora randsi Jell & Hill			x
Alveolites sp. A	x		
Alveolites sp. B		x	
Heliolites daintreei group IV Jones & Hill			x
**Spongophyllum* sp.		x	
**Syringopora* sp.		x	
**?Squameofavosites* sp.		x	
**Heliolites* sp.		x	
*cystiphyllid		x	
*large solitary rugosan		x	

maculosa is known from Pragian and Emsian strata, and the *Squameofavosites squamuliferus* group is typically Early Devonian, although it does range down into the uppermost Silurian. Some further slight support for an Emsian age is indicated by the occurrence of the stromatoporoid *Coenostroma*. In summary, the assemblage is taken to indicate a later Early Devonian age, with a high probability of its being Emsian.

Mile Road Formation. The coral assemblages from this unit are less reliably indicative of age than those of the Touchwood Formation. The best indicator is probably *Endophyllum* cf. *columna*, which suggests a mid-Givetian age. *Thamnopora randsi*, on the other hand, is only known reliably from the mid-Emsian, whereas *Favosites salebrosa* is apparently more typical of Eifelian strata. A small amount of material, offcuts from the original collection of Michael Taylor, was digested in acetic acid (Geological Survey of NSW sample C880), and yielded material of conodont species which indicate a precise age: *Polygnathus linguiformis klapperi* Clausen et al., 1979, *Polygnathus linguiformis weddigei* Clausen et al., 1979, *Polygnathus hemiansatus* Bultynck, 1987 and *Icriodus difficilis* Ziegler et al., 1976. The area of overlap of the ranges of these species, as given by Bultynck (1987, fig. 9) lies in the upper part of the lower *varcus* Zone, of early Givetian age. These taxa are illustrated in Fig. 2.

DISCUSSION

In the Touchwood Formation the dated material all occurs as clasts, and in the Mile Road Formation at least some of the dated material occurs as blocks embedded in a clastic matrix, and none has been shown unequivocally to be autochthonous. Thus the dates provide a maximum age for the units. The presence of fossils in the matrix as well as in blocks in the Mile Road Formation suggests the blocks are penecontemporaneous and hence the Givetian age is taken as that of at least part of the Mile Road Formation. For the Touchwood Formation the interpretation is more equivocal. The limestone here occurs only as clasts which are restricted to a single bed that is a debris flow or the product of a high density turbidity current. Fossils are absent from the surrounding rocks. There is no record of Devonian limestone clasts in any of the Carboniferous or Permian units in this region, and the rocks are of a more mafic provenance than any of the latter units but similar to those of the Frasnian Birdwood Formation of the Yarras district some 25 km further west (Roberts et al., 1995). This suggests the age of the formation lies within the Emsian - Frasnian range, and on the basis of its stratigraphically overlying the Mile Road Formation can be further restricted to Givetian - Frasnian. However, the rocks north of Cowarra Dam mapped as Touchwood Formation have so far yielded no fossils, and the age suggested by the assemblage from the type area is older (Emsian) than that of the possibly underlying Mile Road Formation (early Givetian). Thus either the assemblage from the Touchwood formation in its type area does not yield a true age for the formation or, as originally interpreted by Taylor (1984), the contact between Mile Road Formation and Touchwood Formation north of Cowarra Dam is faulted.

It is noteworthy that the aspect of all fossil

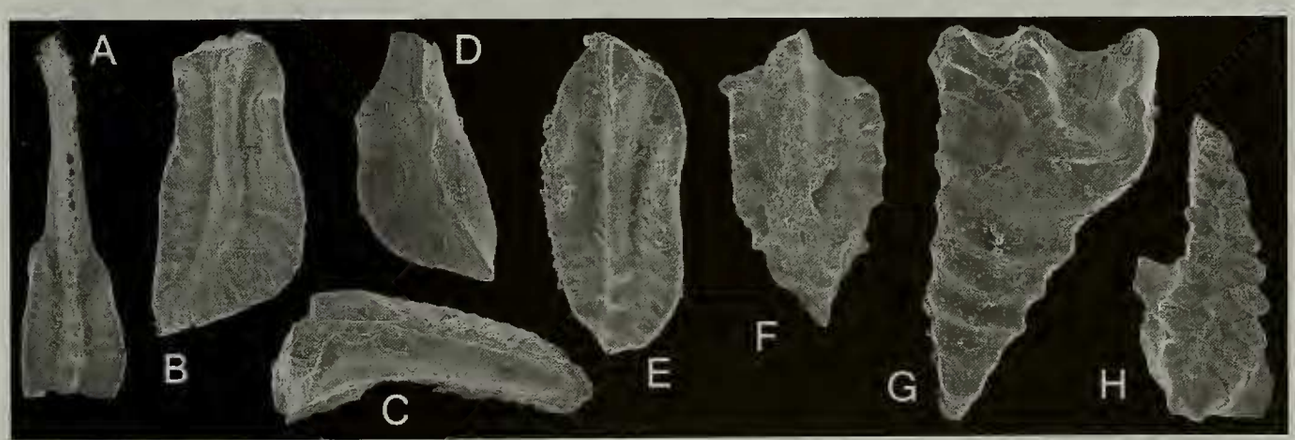


Figure 2. Conodonts from the Mile Road Formation, all x10 except A, x7.5, and E, x20. A –E, Pa elements of *Polygnathus hemiansatus* Bultynck, 1987, B and C are oral and oblique views of the same specimen; E is a juvenile. F, Pa element of *Polygnathus linguiformis weddigei* Clausen et al., 1979. G, Pa element of *Polygnathus linguiformis klapperi* Clausen et al., 1979. H, icriodiform element of *Icriodus difficilis* Ziegler et al., 1976.

assemblages is typically Australian. Several taxa are ascribed to Australian species (*Endophyllum* cf. *columna*, *Xystriphyllum* cf. *mitchelli minus*, *Phillipsastrea* cf. *maculosa*, *Favosites salebrosa*, *Thamnopora randsi*), and the *Squameofavosites squamuliferus* group is very common in Early Devonian assemblages throughout eastern Australia. The genus *Sterictophyllum* is not known outside Australia. Thus although the rocks have been displaced along with the rest of the Hastings Block (e.g. Cawood and Leitch, 1985) their original location was well within the Australian province, probably from a southern continuation of the Tamworth Belt (Roberts and Geeve, 1999). It is also worth noting that in the latter a change in sediment provenance from a region in which intermediate and silicic volcanism was widespread to one dominated by mafic volcanic occurred in the Middle Devonian (Cawood, 1983), a change similar to that which occurred between deposition of the Mile Road and Touchwood Formations.

SYSTEMATIC PALAEONTOLOGY

The material discussed below is held in the collections of the Geological Survey of NSW, indicated by the prefix MMF. Specimens prefixed AM or AMF are held in the Australian Museum, Sydney. Literature citations for authors of taxa above the family level are not cited in the references; they may be found in Hill (1981).

Phylum PORIFERA Grant, 1836
Class ?DEMOSPONGIAE Sollas, 1885
Order uncertain
Family CHAETETIDAE Milne-Edwards & Haime, 1850

Genus *Chaetetes* Fischer von Waldheim in Eichwald, 1829

Type species

Chaetetes cylindraceus Fischer von Waldheim, 1829.

Remarks

The taxonomy of the fossil group informally known as chaetetids has been in a state of flux since the recognition that certain Recent sponges have a chaetetid morphology, although their spicular morphology indicates that they are demosponges (e.g. *Ceratoporella*: Hartman & Goreau, 1972; *Acanthochaetetes*: van Soest, 1984). In the last overview of chaetetids as a taxonomic group (Hill, 1981) they were regarded as tabulate corals; in recent treatises on Porifera (Hooper & Van Soest, 2002; Finks et al., 2004) they have been largely ignored, at least in terms of updated taxonomy: of the twenty-nine available generic names given by Hill (1981) in her review of the "Order" Chaetetida, only two are mentioned in Finks et al. (2004) and three in Hooper & Van Soest (2002). On the other hand, modern genera of "sclerosponges" with chaetetid morphology receive more exhaustive treatment. It is clear from Hill's (1981) introductory remarks that she regarded the group as polyphyletic, but she has also rendered the service of bringing together those names relating to a particular group of morphologies.

In the past, the vertical tubes of chaetetids have usually been referred to as corallites. In view of their highly probably sponge nature this seems inappropriate, so they are here referred to as calicles, the term favoured for similar features in *Ceratoporella* (e.g. Hartman & Goreau, 1972).

Chaetetes sp.

Figure 3 D-G

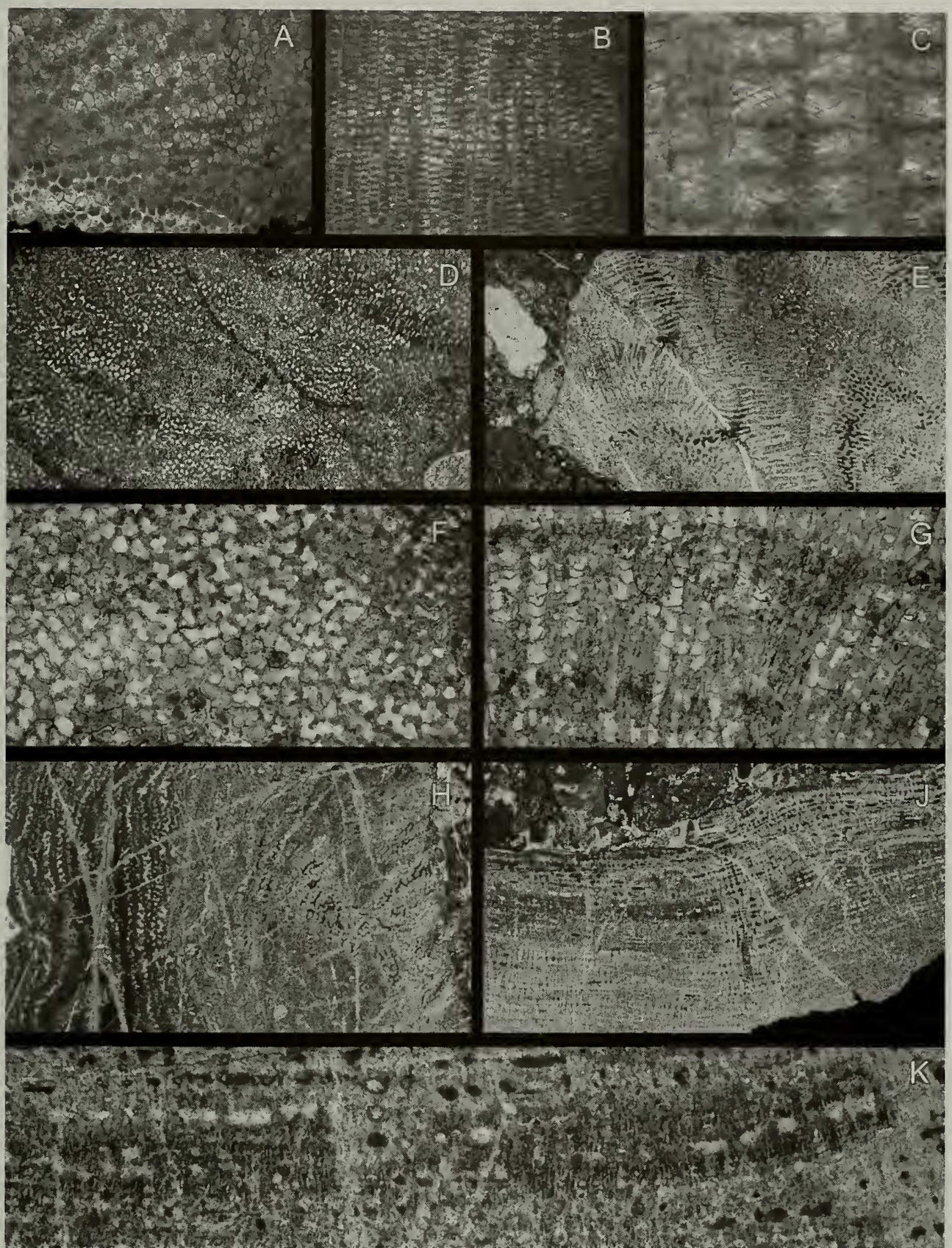
Material

Two specimens, MMF 32039 and 32040, with six thin sections. Locality HRD, probably Emsian.

Description

The species forms small, compact masses reaching at least 5 cm in diameter and 3 cm in height. The shape appears to have been more or less hemispherical, but some thin sections show a surface which bears low mamelons about 7 mm in diameter,

Figure 3 (RIGHT). Spongiomorphs. A-C, topotype specimen of *Litophyllum konincki* (Etheridge & Foord, 1894), MMF884, Reid River Limestone, Reid Gap, S of Townsville, Queensland. A, B, transverse and longitudinal sections, x6; C, detail of B showing vertical trabeculae, x20 approx. D-G, *Chaetetes* sp., Touchwood Formation, locality HRD. D, transverse section, MMF32039b, x 3; E, longitudinal section of specimen with irregular surface, MMF32040a, x3; F, transverse section, MMF32039a, x10; G, longitudinal section, MMF32039c, x10. H-K, *Coenostroma* sp., Touchwood Formation, locality HRD. H, K, tangential and longitudinal sections, MMF44850, x4.5; J, detail of K showing microstructure of micropillars, x15.



whereas others have a smooth surface.

The skeleton is for the most part recrystallised, but some areas reveal it to have been composed of fine, near-vertical monacanthine trabeculae about 0.05 mm in diameter (Fig. 3G). The trabeculae are united to form walls defining subrounded calicles about 0.2 mm in internal diameter; wall thickness at the mid-point is 0.1 – 0.15 mm. In some areas the

calicles are interconnected uniserially, but in a rather meandering pattern (Fig. 3F); in longitudinal section these appear as pores in the walls. The calicles are traversed by fine, rather sagging tabulae c. 0.02 mm thick, generally separated by a distance greater than the width of the calicle, though this is not always the case; they number about eleven in 5 mm. The tabulae display a marked tendency to occur at similar levels in adjacent calicles, and may even be continuous through the mural pores.

Remarks

Chaetetids have been reported from Australia in a number of publications. Etheridge & Foord (1884) described *Amplexopora koninckí* from Reid Gap, south of Townsville, north Queensland (Reid River Limestone, Emsian); Etheridge (1899) reported the species from Tamworth in NSW and erected for it the genus *Litophyllum*. Etheridge's specimen of *L. koninckí* from Tamworth (Australian Museum specimens AM3940, 3941, Moore Creek, near Tamworth, presumably from the Eifelian Moore Creek Limestone) is too recrystallised to show details of wall structure; it is impossible to recognise whether or not there were trabeculae. It does show rare connections between calicles. A topotype specimen (MMF884), rather recrystallised, shows a microstructure of vertical trabeculae similar to those of the Port Macquarie material and of other species of chaetetids (Fig. 3C). However, the tabulae are crowded (23 in 5 mm) and the spaces between them always less than the calicle diameter. Connections between the calicles are rare. I can see no reason for separating *Litophyllum* from *Chaetetes* itself.

Chapman (1918) described *Ch. stelliformis* from Early Devonian Loomberah Limestone of the Tamworth area and, in 1920, *Ch. spinuliferus* from an Early Carboniferous Limestone in the Parish of Mooroowarra, i.e. near Somerton, NSW. Most of the material reported with this locality information derives from the hill known as Watts, Babbinboon (Visean; cf. Campbell, 1957; Pickett, 1967; Moore and Roberts, 1976), but, in spite of intensive collecting, the species has not been found there again. The type specimen in the Museum of Victoria (P73813, with a longitudinal section; the transverse section is apparently lost) is clearly a favositid of the *squamuliferus* group, revised by Philip (1960), though not included in his revision; the age of the specimen is therefore most probably Early Devonian, and the locality data given by Chapman erroneous, since there are no outcrops of Early Devonian rocks within the Parish of Mooroowarra. The species *stelliformis* is now considered a tabulate coral, *Squameofavosites* (Hill, 1950; Philip 1960). Pohler (1998) reported *Pachytheca* cf. *abdita* Yanet, 1972 (in Breyvel' et al., 1972) from a stromatoporoid bioherm in the Moore Creek Limestone Member of the Yarrimie Formation (Eifelian), but the material was not illustrated or described. It may be that this is the same form as Etheridge's (1899) *Litophyllum koninckí*.

Material of *Chaetetes* (MMF44896-7) from the Uglovka Formation in Uglovka quarry, Russia (upper Serpukhovian) is interesting in that one of the specimens grew with a smooth surface, while the other bore abundant mamelons, just as in the Port Macquarie material, suggesting that this apparent dimorphism was a regular feature of chaetetids.

Hill (1981) also included desmidoporids and lichenariids in the order Chaetetida, and the genera *Desmidopora* and *Lichenaria* have both been reported from Australia (Etheridge, 1902; Fitzgerald, 1955; Hill, 1955, 1957). These occurrences are either Ordovician or Silurian; they differ considerably from the present material, and their taxonomic status is not discussed here.

Class STROMATOPOROIDEA Nicholson and Murie, 1878

Order SYRINGOSTROMATIDA Bogoyavlenskaya, 1969

Family COENOSTROMATIDAE Waagen and Wentzel, 1887

Genus *Coenostroma* Winchell, 1867

Type species

Stromatopora monticulifera Winchell, 1866.

***Coenostroma* sp.**

Figure 3 H-K

Material

MMF44860 from locality HRD.

Description

Specimen fragmentary, but in excess of 32 mm wide and 9 mm high. Surface apparently smooth and undulose. Coenostromes dominant, varying widely in thickness from 0.05 to 0.25 mm 8 – 11 in 2 mm, separating galleries 0.07 – 0.13 mm high, and which are subrounded to rather wider than high, consistently on the same level, generally discrete in longitudinal section, but occasionally joined laterally over six or more adjacent galleries. The transverse section shows a single walled tube 0.6 mm in diameter which may be a syringoporellid corallite. Coenosteles strongly

superimposed, up to 20 observed in a vertical series, appearing rather meandrine in tangential section. Microstructure reticulate, of clearly defined micropillars which are normal to the surface, appearing as dark spots in tangential section.

Remarks

Coenostroma species do not form a conspicuous element of eastern Australian Early and Middle Devonian faunas, as far as they are known (e.g. Webby et al., 1993; Webby & Zhen, 1993, 1997), the only published report being *Coenostroma* sp. from the Early Emsian (*dehiscens* Zone) Buchan Caves Limestone and Heath's Quarry, Buchan, Victoria (Webby et al., 1993). The present material differs from this in its more crowded coenostromes, coenosteles which are more strongly superposed, and apparently also in the prominent micropillars of the coenosteles.

Phylum COELENTERATA Frey and Leuckart, 1847
Class ANTHOZOA Ehrenberg, 1834
Subclass RUGOSA Milne Edwards and Haime, 1850
Order STAURIIDA Verrill, 1865
Family ENDOPHYLLIDAE Torley, 1933

Genus *Endophyllum* Milne-Edwards & Haime, 1851

Type species

Endophyllum bowerbanki Milne-Edwards & Haime 1951.

***Endophyllum* cf. *columna* Hill, 1942a**

Figures 4 A-B, 5A

Material

MMF29212a, 29213a, with two thin sections. Locality MRF.

Description

Corallum cerioid, exceeding 10 cm in diameter. Epitheca 0.4 – 0.5 mm thick, showing strong median dark line. Maximum corallite diameters are 7 – 10 mm. Septa 18 – 22 in each order, the major septa extending well into the tabularium and sometimes almost reaching the axis. Minor septa also enter the tabularium but inside the presepiments are only about half as long as the major septa. Even in young corallites both orders are interrupted peripherally by up to four rows of steep to almost horizontal presepiments, some of the inner ones bearing septal crests corresponding to both orders of septa. Tabularium 4.5 – 6.0 mm wide, with tabulae which are flat or slightly concave near the axis, but turned strongly down and then back up again in the outer tabularium; 9 or 10 tabulae in 5 mm.

Remarks

The Queensland species *Endophyllum columna* Hill most nearly approaches the present material in corallite dimensions, though it is generally slightly larger, in both corallite diameter (10 – 22 mm) and tabularium diameter (6 – 9 mm), and the wall thickness is rather less (0.05 – 0.15 mm). Of the other Australian species of *Endophyllum* still referred to that genus, *E. jelli* Zhen, 1994 has a much wider tabularium (10 mm), *E. giganteum* Zhen & Jell, 1996 has much larger corallites (24 – 40 mm), and *E. banksi* Jell & Hill, 1970a has much larger corallites and more than twice as many septa.

Endophyllum columna occurs in the upper part of the Burdekin Formation and the lower beds of the Cultivation Gully Formation, and is ascribed a mid-Givetian age by Zhen and Jell (1996).

Family PTENOPHYLLIDAE Wedekind, 1923

Genus *Acanthophyllum* Dybowski, 1873

Type species

Cyathophyllum heterophyllum Milne-Edwards & Haime, 1851.

***Acanthophyllum* sp.**

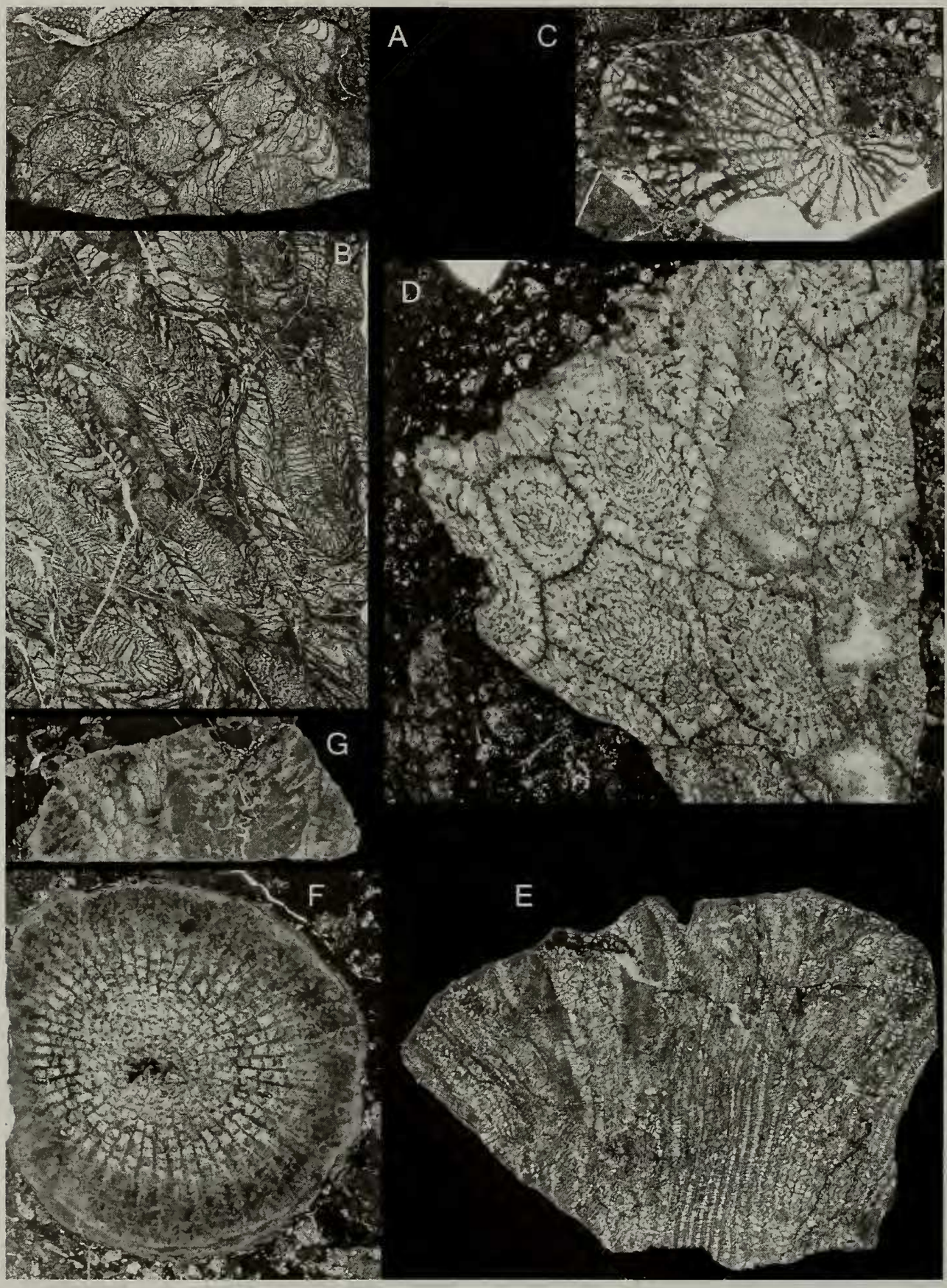
Figure 4C

Material

MMF32041, locality HRD.

Description

The single specimen is a somewhat oblique thin section of an eroded corallite near 10 mm in diameter. In spite of the obliquity of the section the tabularium appears to be oval rather than round. There are an estimated 28 major septa; both orders of septa are thickened in the dissepimentarium, being thickest in its central part. Near the epitheca they are quite thin. Minor septa only just reach the tabularium. Septa are smooth and strongly trabeculate and in their thickest parts they show a clear zone of trabecular divergence. Major septa extend almost to the axis; they are straight in the dissepimentarium but become wavy in the tabularium. There is a degree of bilaterality of septa coinciding with the long axis of the section, and at its margin, on this axis, lies a very short septum, possibly the counter septum, situated between a major septum on one side and a minor septum on the other. The dissepimentarium accounts for about half the radius of the corallite, the estimated diameter of the tabularium being 6 mm.



Remarks

Most acanthophyllids described from Australia have a calyx which is either bell-shaped or inverted conical. Strusz (1966) took these two calical shapes as the distinguishing character between the subgenera *Acanthophyllum* and *Neostringophyllum*, although this differentiation has not always been supported

(e.g. Hill, 1981). The only material showing pronounced fusiform dilatation of the septa in the dissepimentarium has been referred to the related species *Acanthophyllum clermontense* (Etheridge, 1911) and *A. kennediense* Yu & Jell 1990, both of which are much larger than the present specimen, which is not necessarily a fully grown individual. If the smaller size is a reliable indication, it comes closest to the material from the Garra Formation referred to *A.* aff. *clermontense* by Strusz (1966). The Queensland reports of *A. clermontense* are from the Emsian (*perbonus* to *inversus* Zones; Mawson & Talent, 2003) Douglas Creek Limestone and the late Emsian Mount Podge Limestone (Zhen, 1995); *A. kennediense* is from the older, Lochkovian to Pragian Shield Creek Formation (Yu & Jell, 1990). Most of Struzs's material from the Garra Formation comes from the upper levels, so the age is probably late Emsian (Mawson & Talent, 2000).

Genus *Xystriphyllum* Hill, 1939

Type species

Cyathophyllum dunstani Etheridge, 1911.

***Xystriphyllum* cf. *mitchelli minus* Pedder, 1970a (in Pedder et al., 1970a)**

Figure 4D

Material

MMF32042, MMF44865 from locality HRD.

Description

One specimen is a small piece of a cerioid colony which is too thin to permit preparation of a thin section, but the other has yielded a transverse section. The weathered surface shows about 20 corallites more or less in cross section. Corallites range in diameter from 4.2 mm to 5.8 mm and have 16 – 18 septa in each order. The major septa reach or almost reach the axis, but do not appear to interdigitate.

Remarks

In size and septal number the specimen falls within the ranges of the three smallest species of *Xystriphyllum* known from Australia. *Xystriphyllum insigne* Hill, 1940a, from Limestone Siding, Silverwood, Queensland, has diameters in the range 2 – 4 mm with 12 – 13 septa of each order; the corallites of *X. mitchelli minus* Pedder, 1970 (in Pedder et al., 1970a), from the Taemas Limestone, Wee Jasper, N.S.W. (mid-Emsian) are less than 6 mm in diameter, with no more than 20 septa of each order; and *X. parvum* Yu & Jell, 1990 has 12 – 15 septa and diameters of 4 – 4.5 mm. Yu & Jell (1990) indicate a Lochkovian to Pragian age for *X. parvum*; Mawson & Talent (1989, fig. 2) suggest an age in the *pesavis – sulcatus* Zones, which is in direct agreement with that of Yu & Jell.

If weight is given to the septal number in determining the species, then the present material comes closest to *X. mitchelli minus*. This form is known only from the Emsian Taemas Limestone, from a level within the *perbonus-gronbergi* Zone (Pedder et al., 1970a; Mawson & Talent, 2000).

Family PHILLIPSASTREIDAE Hill, 1954

Genus *Phillipsastrea* d'Orbigny, 1849

Type species

Astrea (Siderastrea) hennahi Lonsdale, 1840.

***Phillipastrea* cf. *maculosa* Hill, 1942c**

Figures 4E, 5B

Material

MMF44866, a single fragment from locality HRD, from which only a longitudinal section could be prepared.

Description

The slide shows longitudinal sections of one tabularium of an astraeoid or thamnastraeoid coral, 5 mm in diameter and bounded on either side by strongly thickened, trabecular fans of a septal stereozone and its associated ring of horseshoe dissepiments. The fans are 1.5 – 2.0 mm wide. Septa are robust even in the outer dissepimentarium, and the dissepimentarial profile indicates that the everted calyces were raised

Figure 4 (LEFT). Rugose corals from the Touchwood and Mile Road Formations. A, B, *Endophyllum* cf. *columna* Hill, 1942, Mile Road Formation, locality MRF, transverse and oblique longitudinal sections, MMF29213a and 29212a respectively, x1.6. C, *Acanthophyllum* sp., Touchwood Formation, locality HRD, oblique section, MMF32041, x3.5. D, *Xystriphyllum* cf. *mitchelli minus* Pedder, 1970, Touchwood Formation, locality HRD, transverse section MMF44865, x4.3. E, *Phillipsastrea* cf. *maculosa* Hill, 1942, Touchwood Formation, locality HRD, longitudinal section, MMF44866, x3. F, G, *Sterictophyllum* sp., Touchwood Formation, locality HRD, transverse and longitudinal sections, MMF44861, x4.5.

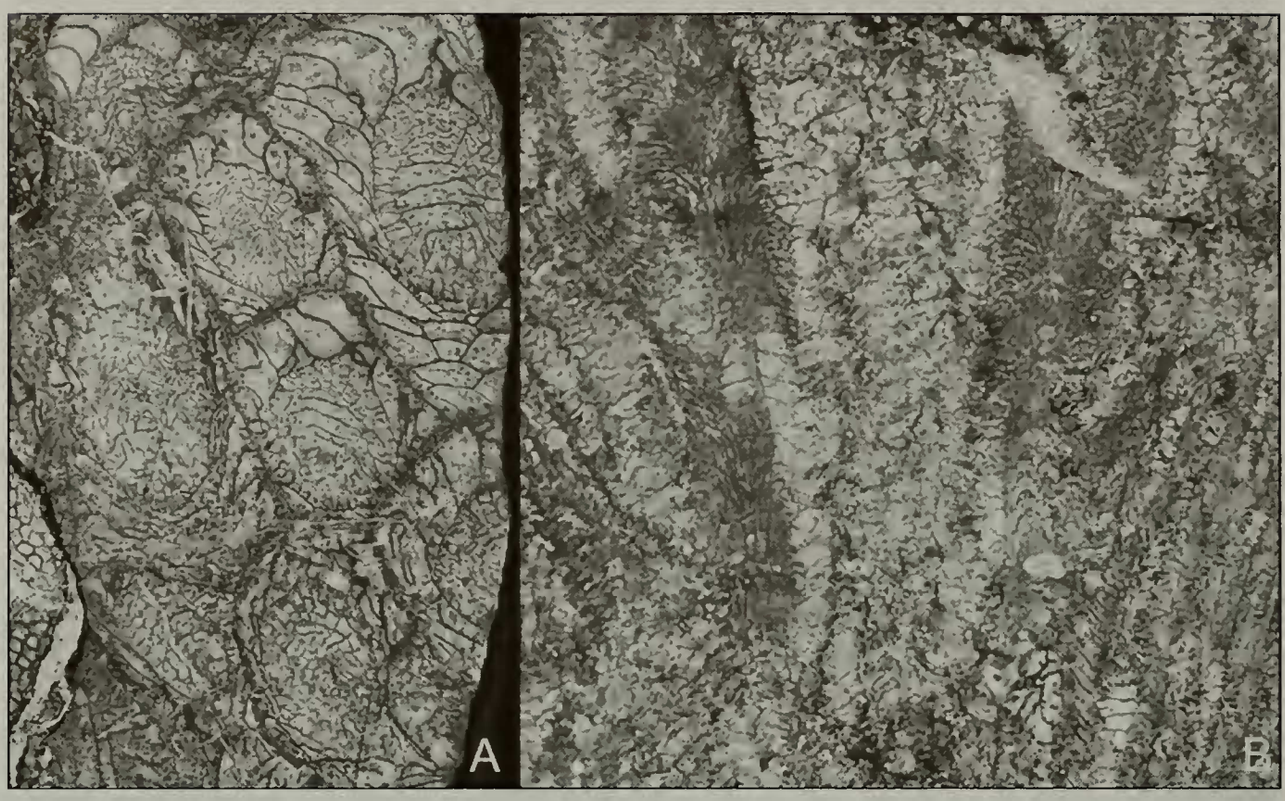


Figure 5. Detail of material from Figure 4. A, *Endophyllum* cf. *columna* Hill, 1942, Mile Road Formation, locality MRF, showing details of septa and budding corallite (centre) MMF29213a, x 2.8. B, *Phillipsastrea* cf. *maculosa* Hill, 1942, Touchwood Formation, locality HRD, MMF44866, showing long major septa and details of traabecular fans and horseshoe dissepiments, x 8.8.

only a millimetre or so above the general level of the dissepimentarium. Trabeculae stout, 0.1 – 0.45 mm in diameter. Tabulae incomplete, the tabularial floor more or less flat or somewhat raised axially, the rather confused nature of the section suggesting that the major septa extend close to the axis.

Remarks

Tabularia are rather larger than those of the type material ("about 3 mm"), but in its general robustness the specimen is much closer to *P. maculosa* than any other Australian species currently referred to the genus. The tabularia of *Bensonastraea praetor* Pedder, 1966 are similar in dimensions, but that genus has strongly vepreculate septa, of which the present material gives no indication; the septa of *B. praetor* are also less robust than those of the Port Macquarie specimen. The tabularia of *P. carinata* Hill, 1942a are only 3 mm wide and, as the name implies, the septa are strongly carinate. *P. oculoides* Hill, 1942d, from the Garra Formation, has tabularia similar in width to those of the present specimen, but the septa of that species are so short that major and minor septa are of nearly the same length, and the tabulae are concave or nearly horizontal (see also Wright, 2008). *Phillipsastrea currani* Etheridge, 1892, as redescribed by Pedder (in Pedder et al., 1970a), has tabularia up to 4 mm in diameter, short major septa and horseshoe dissepiments which are not continuously developed. Finally, the recently described *P. scotti* Wright, 2008, is also close to the present form, but the Port Macquarie material is too scant for confident attribution to either this species or *P. maculosa.*

Phillipsastrea maculosa is known from its type locality in the Sulcor Limestone (Emsian, *serotinus* Zone, Mawson & Talent, 2000), from the Liptrap Formation at Waratah Bay (Hill, 1954; Emsian, *perbonus-gronbergi* Zone, Mawson & Talent, 2000), the Coopers Creek Limestone at Tyers in Victoria (Philip, 1962; Pragian, *sulcatus* to *pireneae* Zones, Mawson & Talent, 1994b) and the Late Emsian (*serotinus* Zone) Mount Podge Limestone Zhen, 1995). *Phillipsastrea scotti* is also of *serotinus* Zone age.

Suborder CYATHOPHYLLINA Nicholson, 1889
Family CYATHOPHYLLIDAE Dana, 1846
Genus *Stereictophyllum* Pedder, 1965

Type species

Cyathophyllum cresswelli Chapman, 1925.

***Sterictophyllum* sp.**

Figure 4 F-G

Material

A single specimen MMF44861 from locality HRD, with a transverse and a partial longitudinal section.

Description

Corallum solitary, apparently cylindrical, with a maximum diameter of 14.7 mm. Septa long, strongly radial, of two orders, forming a marginal stereozone about 3 mm wide, in which the trabeculae are clearly visible. Septa 25 in each order, the major septa reaching the axis, where they are carinate; minor septa long, entering the tabularium. Septa of both orders taper abruptly after leaving the stereozone.

The imperfect longitudinal section shows no details of the tabulae, but shows the numerous, steeply inclined dissepiments inside the stereozone, and the carinate septa near the axis. The tabularium is 5.5 mm wide. Within the stereozone sections of laterally-growing trabeculae appear as dark spots; in the inner dissepimentarium they are only slightly inclined towards the axis.

Remarks

The present specimen is smaller than the maximum diameters quoted for any of the Australian species referred to *Sterictophyllum*, although a single specimen cannot give any impression of the range of variation. The stereozone is thicker than in the other species (*S. creswelli* (Chapman, 1925) – 2 mm; *S. vallatum* Pedder, 1965 – 2.5 mm; *S. pridianum* (Philip, 1962) – 1.5 – 2.5 mm); in *S. vallatum*, however, the major septa do not reach the axis. On the basis of its relative dimensions, the present form appears to be closest to *S. pridianum*. (A fourth species, *Mictophyllum trochoides* Hill, 1940b, type species of *Cavanophyllum* Pedder, 1964, has been included in the genus by Jell & Hill, 1969, but has major septa which are somewhat contorted at the axis, lacks the pronounced stereozone, and is much larger than all the others. It is not further considered here).

All these species are Early Devonian in age. The type species (sensu stricto) is known only from its type locality in the Lilydale Limestone at Lilydale, Victoria (Pragian, *kindlei – pireneae* Zones; Mawson & Talent, 2000); both the other species come from the Limestone phase of the Coopers Creek Formation (Pragian, *sulcatus* to possibly *dehiscens* Zones; Mawson & Talent, 2000).

Subclass TABULATA Milne-Edwards & Haime, 1850

Family FAVOSITIDAE Dana, 1846

Genus *Favosites* Lamarck, 1816

Type species

Favosites gothlandicus Milne-Edwards and Haime, 1850.

***Favosites salebrosa* Etheridge, 1899**

Figure 6 A-B

Synonymy

1899 *Favosites basaltica* var. *salebrosa* Etheridge, p. 166, pl. 21 figs 3-5, pl 27, figs 1-2.

1937 *Favosites salebrosa* Etheridge; Jones, p. 95, pl. 14, figs 2-6.

1940 *Favosites salebrosus* Etheridge; Hill and Jones, p. 197.

2002 *Favosites* sp. aff. *F. salebrosus* Etheridge; Pohler, p. 19, figs 5A-D

Material

MMF 44857 from the Mile Road Formation, locality SC.

Description

The material is from fragments of a large, massive colony, exceeding 70 x 45 cm in original dimensions. Corallites range in diameter from 0.65 to 0.83 mm, with a mean at 0.73. Wall thickness ranges from 0.05 to 0.14, mean 0.06. Mural pores are 0.2 – 0.3 mm in diameter and at least 0.6 mm apart. Septal spines are neither conspicuous nor frequent, projecting 0.2 mm from the wall. There are 14 – 18 complete tabulae in 10 mm.

Remarks

The material accords well with the sections of the lectotype (AMF 4288. sections AM 47A, B) from the Woolomol Limestone, in portion 38, parish of Woolomol, northwest of Tamworth, N.S.W., in which I have measured rare corallites with a diameter of as much as 0.9 mm. Jones (1937) reports the species from what is probably the Cavan Bluff Limestone at Taemas, without illustration or nomination of material; this equates to the middle part of the Cavan Formation of Pedder et al. (1970a), of early Emsian (*dehiscens* Zone) age. For the type locality, neither Hill (1942c), Brown (1942) nor any of the publications of the Macquarie University group (e.g. Mawson and Talent, 1994a; Pohler, 2001) provides information which helps age determination. However, this limestone outcrop,

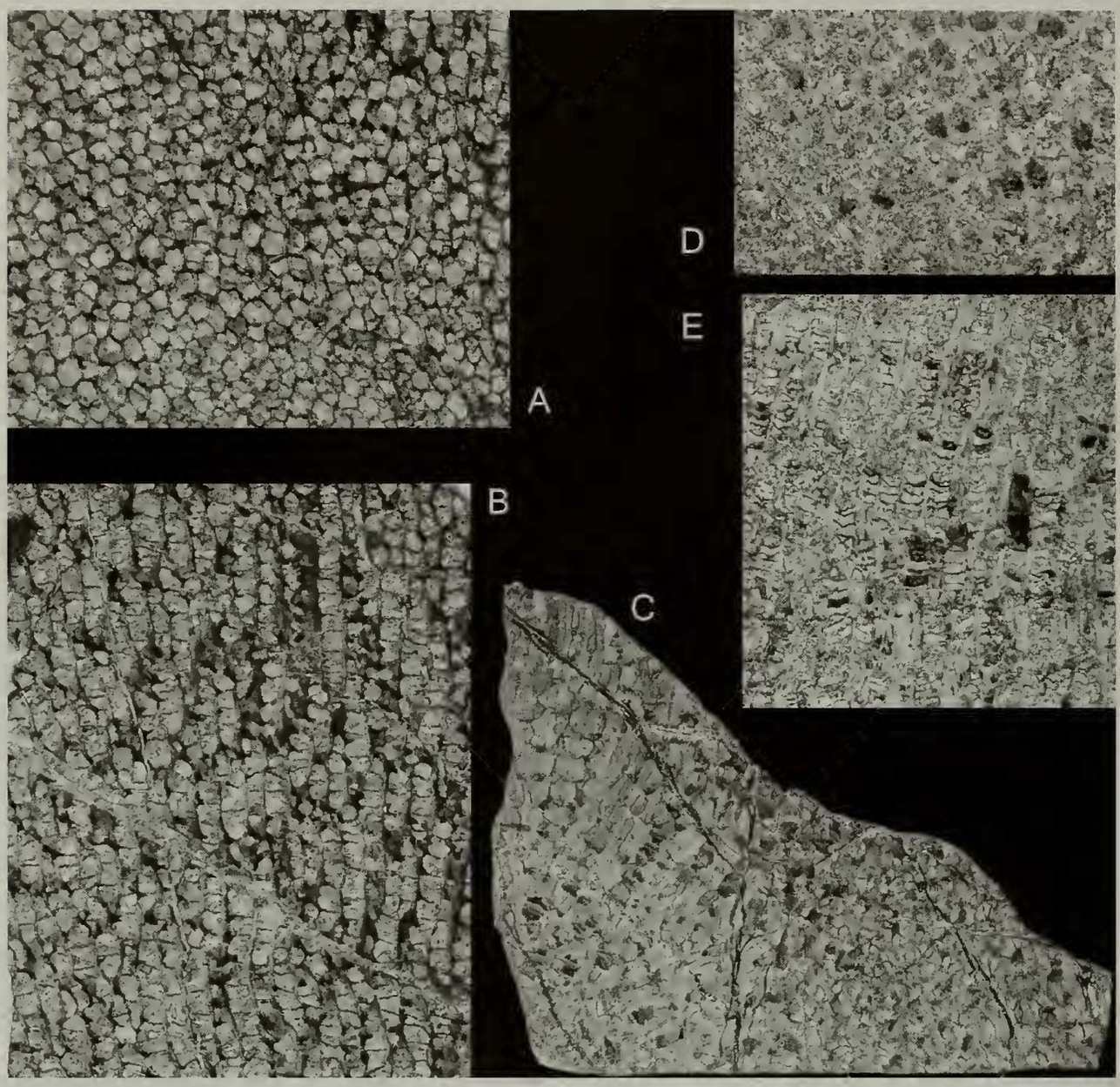


Figure 6. Tabulate corals from the Touchwood and Mile Road Formations. A, B, *Favosites salebrosa* Etheridge, 1899, Mile Road Formation, locality SC, transverse and longitudinal sections, MMF44857, x5. C, ?*Pachyfavosites* sp., Touchwood Formation, locality HRD, predominantly longitudinal section, MMF44863, x4. D, E, *Squameofavosites squamuliferus* (Etheridge, 1899), transverse and longitudinal sections, MMF32037, x3.7.

in adjacent portions, is the type locality for some of the sponges described by Pickett (1969), which are also characteristic of the lowermost beds of the Timor Limestone to the southeast. For this interval Pedder et al. (1970a) have determined an earliest Eifelian age, so it is probable that the so-called Woolomol Limestone is more or less coeval. On the other hand, Pohler (2001, p. 96) indicates that all favositids from the Tamworth district examined by her are Emsian in age, and later (Pohler, 2002) describes *Favosites* aff. *F. salebrosus* from the Emsian Sulcor Limestone, but her material forms cylindrical branches of at least 3 cm diameter, in contrast to the type material, which is massive, and certainly the present material, which forms large masses.

Genus *Pachyfavosites* Sokolov, 1952

Type species

Calamopora polymorpha var. *tuberosa* Goldfuss, 1826.

***?Pachyfavosites* sp.**

Figure 6C

Material

A single specimen, MMF 44863, from locality HRD, with two thin sections.

Description

Corallum massive, original form unknown. Surface possibly with raised areas. Corallites four to six sided, 1 – 1.3 mm in diameter. Walls immensely thickened, so that the lumen diameter is 0.2 – 0.7 mm, and composed of large bundles of calcite fibres. Mural pores prominent, about 0.2 mm in diameter. Tabulae complete, more or less horizontal, irregularly spaced, possibly reach as many as 14 in 5 mm.

Remarks

This species is much more thickened than the type, or any other species referred to the genus by the Russian school, such as *P. markovskyi* (fide Sokolov, 1962), as the lumen may be all but occluded. In this respect it is similar to the mature stages of *Riphaeolites* Yanet in Sokolov, 1955 (tentatively included in the family Cleistoporidae by Hill, 1981), but the present material shows no indication of the early, less thickened favositid stage characteristic of that genus .

Pachyfavosites has been reported from Australia by Pohler (2002), who illustrates both *P. rariporosus* Dubatolov, 1963 and *P. tumulosus* Yanet, 1965 from the Emsian Sulcor Limestone Member of the Yarrimie Formation near Tamworth, NSW; neither of these species has the intense thickening of the Port Macquarie material. *Riphaeolites* is restricted to a single doubtful record from an unspecified Emsian limestone (Sulcor?) from the Tamworth area (Pohler, 1998), unaccompanied by either description or illustration.

Genus *Squameofavosites* Chernyshev, 1941

Type species

Favosites hemisphericus var. *bohemica* Počta, 1902.

***Squameofavosites squamuliferus* (Etheridge 1899)**

Figure 6 D-E

Material

MMF32027, with three thin sections; locality HRD.

Description

The single specimen is a fragment of a cerioid colony 30 x 15 mm in diameter and c. 30 mm high. Corallite diameter ranges from 1.0 to 1.25 mm, diameters in the lower range being more common. Wall thickness is variable, from 0.1 to as much as 0.27 mm. Squamulae, though present, are not obvious, the longest one observed being only 0.1 mm in length. There are 33 – 40 tabulae per cm. Mural pores have a diameter close to 0.2 mm, but the preservation is such that measurements are imprecise. The vertical distance between their centres is 0.7 – 0.9 mm.

Remarks

Forms which may be referred to the *squamuliferus* group in Australia make a fairly homogeneous assortment (cf. Philip, 1960). The range of variation described by Philip (1960, notably figs 2, 3) suggests continuous variation between most of these forms.

All of the material described by Philip (1960), and the type material of the various taxa involved, derives from strata of Early Devonian age; in central western New South Wales the group ranges down into Late Silurian strata (Pickett & Ingpen, 1990; Pickett & McClatchie, 1991).

Philip (1960) referred the taxa in this group either to *Squameofavosites grandiporus* (Etheridge, 1890) or to "formae" within *Squameofavosites squamuliferus* (Etheridge, 1899), these latter comprising some eight subspecific units designated by the first eight Greek letters, and for the first five of which names in the species category are available (*bryani* Jones, 1937; *nitidus* Chapman, 1914; *stelliformis* Chapman, 1918; *australis* Chapman, 1907; *ovatiporus* Hill & Jones, 1940). The present specimen fits within the range reported for forma *bryani* (Jones, 1937), the type locality of which is in the Taemas Limestone at Good Hope, NSW, and which Philip reports from the "Tyers River Limestone"; both these localities are Emsian, though the lack of precise localities makes it difficult to assess the age more accurately.

Family PACHYPORIDAE Gerth, 1921

Genus *Cladopora* Hall, 1851

Type species

Cladopora seriata Hall, 1851.

Remarks

Following a revision of the type species by Oliver (1963), Hill (1981) restricts the genus to those species whose calices are lozenge-shaped in their mature portion. This definition excludes most of the Australian species previously included in the genus. Since the restricted material of this study does not

allow the observations necessary for more rigorous treatment, forms with a consistently rounded calyx are also treated here.

***Cladopora* sp.**
Figure 7 A-B

Material

MMF 23038, a single fragment of a branching colony, with one oblique thin section; locality HRD.

Description

The colony is cerioid and branching, the branch 4 mm in diameter. Corallites very small, many in

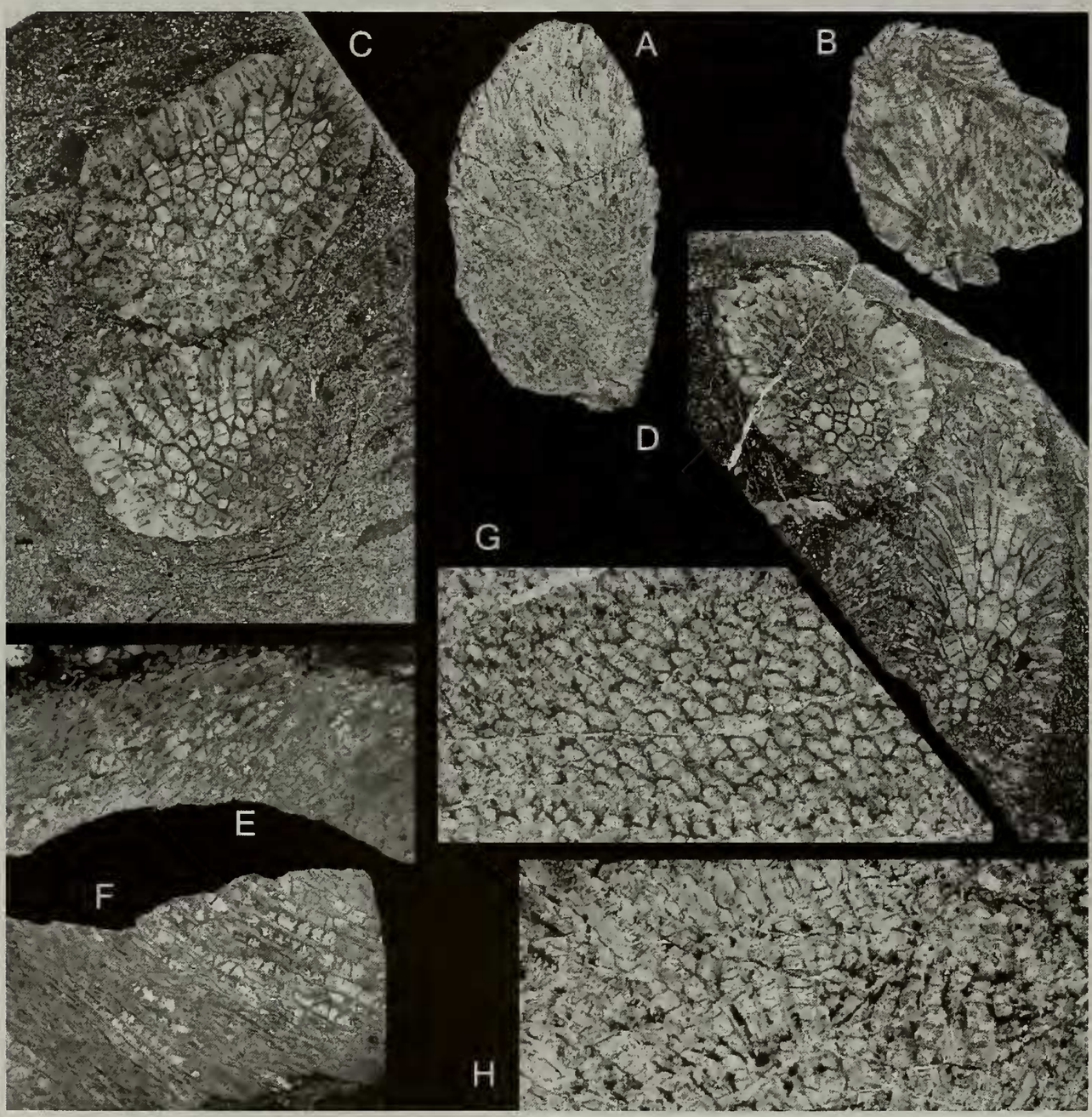


Figure 7. Tabulate corals from the Touchwood and Mile Road Formations. A, B, *Cladopora* sp., Touchwood Formation, locality HRD, oblique sections of branches. A, MMF32028d, x7.5; B, MMF32038b, x7.8. C, D, *Thamnopora randsi* Jell & Hill, 1970. Mile Road Formation, locality SC, random sections, MMF44858, x2.5. Note bioturbation burrows in C. E, F, *Alveolites* sp. A., Touchwood Formation, locality HRD. E, transverse section, MMF32038c, x4.8; F, longitudinal section MMF32038a, x5. G, H, *Alveolites* sp. B, Mile Road Formation, locality MRF, portions of large specimen MMF29213a with areas of transverse (G) and longitudinal (H) orientation, x5.

the cross-section of a branch (at least 18 along a diameter), rounded in transverse section axially, but lozenge-shaped towards the margin, 0.35 – 0.4 mm in maximum diameter, vertical at the axis and curved gradually towards the surface, which they reach at an acute angle. Walls thick relative to size of corallites, without any obvious thickening towards the surface. Tabulae not observed; there is some indication that the calices were back-filled with lamellar calcite rather than by tabulae. Septal spines not observed.

Remarks

Among the Australian species referred to *Cladopora*, *C. foliata* (Jones,1941) is encrusting; *C. gippslandica* (Chapman, 1907), originally described as a bryozoan, and redescribed by Philip (1962), does not appear to have the lozenge-shaped calices of the present form; three species from Victoria (Talent, 1963) (*lemaitreae, corrigia, surculus*) are all described as having rounded apertures. I have examined the type specimen of *Cladopora mirabilis* (Etheridge, 1917) (AMF899; 4 thin sections) from the Reid River Limestone at Reid Gap, south of Townsville, Queensland. This species forms branches 2 – 3 mm in diameter in which the axial corallites are subrounded, becoming lozenge-shaped only towards the periphery. In longitudinal section they curve gently towards the periphery, without geniculation. There are 6 – 7 corallites along a diameter. Mural pores are common, tabulae rare, and the wall displays a prominent median dark line. The present material differs markedly from *C. mirabilis* in the much smaller and more crowded corallites.

Genus *Thamnopora* Steininger, 1831

Type species

Thamnopora madreporacea Steininger, 1831 (= *Alveolites cervicornis* de Blainville, 1830).

***Thamnopora randsi* Jell and Hill, 1970b**

Figure 7 C-D

Material

Two large blocks of mudstone containing abundantly branching coralla, MMF 44858 (2 thin sections), MMF 44869, Mile Road Formation, locality SC.

Description

Corallum branching, bifurcating, branches cylindrical, 6 – 14 mm in diameter, mature branches being generally in the upper range. In transverse section there are 8 – 10 corallites along the median plane of a mature branch. Diameter of mature corallites 1.2 – 1.5 mm, their combined walls about 0.2 mm in thickness near the axis, and 0.6 – 0.8 mm in the outer stereozone, which is 2.5 – 3 mm wide. In the inner parts of the branches the walls show a conspicuous median dark line, but this becomes much more diffuse in the outer stereozone, where the stereome may show a lamination parallel to the surface. Near the axis the corallites are parallel to the branch, but turn outwards without geniculation to reach the sides of the branch at about 45°. Mural pores have a diameter of 0.2 – 0.3 mm, and are rather funnel-shaped in the stereozone. They occur in a single series on the faces of the corallites. Calices are 3 – 4 mm deep. Septal spines are rare, < 0.1 mm in length, conical, not trabeculate, and occur both at the axis and in the stereozone. Latex replicas from natural moulds show no sign of septal ridges in the calyces. Tabulae are complete, lie closer together than the width of the corallite, usually 4 in 2 mm.

Remarks

The present material accords well with that described by Jell and Hill (1970b), though the branches are slightly thinner (14 mm as against 15 mm in the types), and the corallites open slightly more obliquely to the sides of the branches. A significant similarity is the way the median dark line becomes less obvious towards the exterior, and the presence of growth lamination in these areas. *Thamnopora plumosa* Jones, 1941 has much stouter branches with nearly twice as many corallites across the median plane, and the thickening is less conspicuous. *Thamnopora foliata* Jones, 1941 is laminate; *T. meridionalis* (Nicholson and Etheridge, 1879) is more delicately branched; *T. crummeri* (Etheridge, 1899) is closer, but has fewer corallites across the median plane and the difference in the amount of thickening between the axial and outer zones is less pronounced (I have examined the sections of the holotype, AM 3981 and 4687). The Victorian species, *T. alterivalis* (Chapman, 1914), *T. angulata* Hill, 1950 and *T. tumulosa* Hill, 1950 all have significantly thinner branches, the largest reaching only 7 mm.

Thamnopora randsi is known so far only from its type area, the Douglas Creek Limestone, of Clermont, Queensland (mid-Emsian, *perbonus* to *inversus* Zones; Mawson & Talent, 2003).

Family ALVEOLITIDAE Duncan, 1872

Genus *Alveolites* Lamarck, 1801

Type species

Alveolites suborbicularis Lamarck, 1801.

***Alveolites* sp. A**

Figure 7 E-F

Material

Four indifferently preserved specimens, MMF32038, 44862, 44867 and 44868, with six thin sections, all from locality HRD.

Description

All the material is of small fragments, the largest being less than 2 cm in maximum diameter. Corallites usually crescentic, apparently reclined, up to 0.4 mm high and 0.8 – 1.0 mm wide. Squamulae, septal spines and mural pores not observed. Tabulae 0.25 – 0.4 mm apart.

***Alveolites* sp. B**

Figure 7 G-H

Material

Three specimens, MMF 29213 – 29315, with three thin sections, all from locality MRF.

Description

Corallum moderately large, exceeding 10 cm in maximum dimension. Corallites generally crescentic, but occasionally polygonal, 0.3 – 0.5 mm high and 0.5 – 0.7 mm wide. Occasional short septal spines occur on the side of the corallite away from the curved surface. The wall thickness varies considerably within the corallum, some areas having corallites whose walls reach only 0.02 mm, but for the most part the walls are thickened, reaching 0.1 or even 0.2 mm in extreme cases. The non-thickened areas pass rather abruptly into thickened areas, and individual corallites may lie partly in each of the two. There are occasional mural pores. Tabulae are at right angles to the direction of growth of the corallite, thin even in the thickened parts of the corallum, complete, and 0.2 – 0.6 mm apart.

Remarks

For all that the Australian literature refers to some twenty species of *Alveolites* (Pickett, 1999), the genus is not well documented in this country, either morphologically or stratigraphically. Six species (*caudatus* Hill, 1954; *intermixtus* Lecompte, 1939; *multiperforatus* Salée, 1916 (in Lecompte, 1933); *saleei* Lecompte, 1933; *suborbicularis* Lamarck, 1801; *tumida* Hinde, 1890) are known from Late Devonian strata in Western Australia. A further two were established by de Koninck (1876; *obscurus*, *rapa*) and, as the type material was destroyed by fire and details of the type localities are vague, it is probably better that the names be allowed to languish; his other three reports are unillustrated and, based as they are on external features alone, should be regarded as dubious. Chapman's (1921) species *regularis* and *victoriae* were regarded as species of *Favosites* by Philip (1960).

The status of the remaining eight taxa is not necessarily sound. The holotype of the only Silurian species, *Alveolites piriformalis* Etheridge, 1921 from the Yass district, has never been traced, and its internal structure is inadequately known. The holotype of *A. queenslandensis* Etheridge & Foord, 1884, from the Emsian Reid River Limestone at Reid Gap, south of Townsville, has not been traced and the species has not been redescribed since the original publication. Hill et al. (1967) illustrated, without description, forms referred to *A.* sp. ex gr. *fecundus* (Salée, 1916) and *A.* sp. nov. aff. *lemniscus* Smith, 1933, of which the first has a branching corallum and the second does not show the areas of thin- and thick-walled corallites of *A.* sp. B. from locality MRF. *Alveolites stamineus* Hill, 1950 from the Emsian Murrindal Limestone at Buchan, Victoria, is a distinctive, thinly encrusting form. Neither of the forms referred to *A. suborbicularis* Lamarck, 1801 or *A.* sp. nov. aff. *A. hemisphericus* (Chernyshev, 1937) by Brühl & Pohler (1999) shows areas of thin- and thick-walled corallites, apart from the thinner-walled basal layer of *A. suborbicularis*. Finally, the material referred to *A.* sp. aff. *A. taenioformis* Schlüter, 1899 by Philip (1962) forms encrusting layers no more than 4 mm in thickness.

The material described here as *Alveolites* sp. A is too scant for proper identification, and that described as *Alveolites* sp. B does not appear to be the same as any Australian forms so far reported.

Order HELIOLITIDA Frech, 1897

Family HELIOLITIDAE Lindström, 1876

Genus *Heliolites* Dana, 1846

Type species

Astraea porosa Goldfuss, 1826.

***Heliolites daintreei* Nicholson & Etheridge, 1879 group IV Jones & Hill, 1940**

Figure 8

Material

Two specimens, fragments of much larger

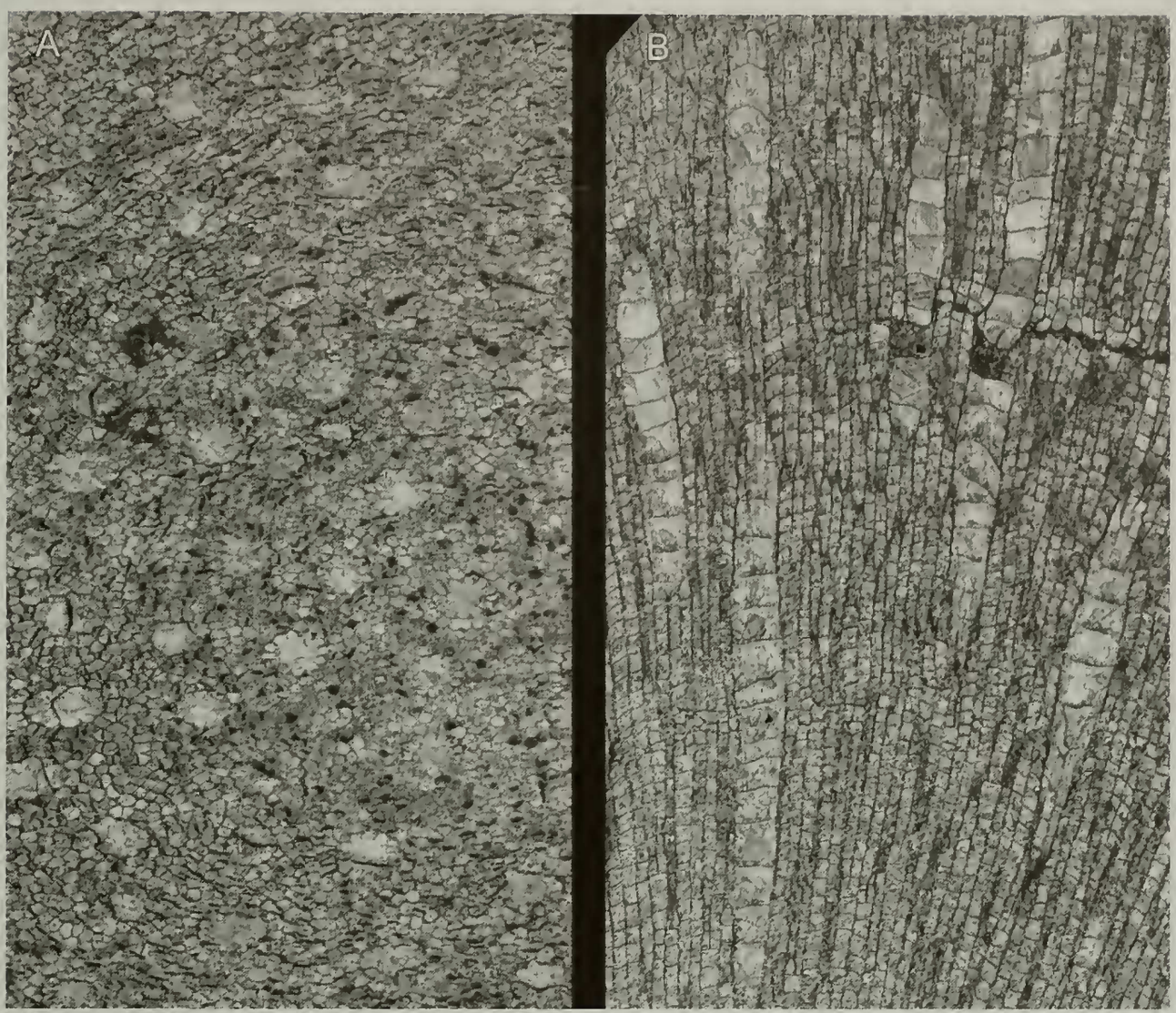


Figure 8. Tabulate corals from the Mile Road Formation, locality SC. A, B, *Heliolites daintreei* Nicholson & Etheridge, 1879, group IV Jones & Hill, 1940. A, transverse section MMF44856, x5.3; B, longitudinal section MMF44859, x5.7.

colonies, MMF 44856, 44859, from locality Sarahs Creek.

Description

Corallum massive, large. Tabularia consistently 1.2 mm in diameter, but ranging up to 1.5 mm. No areola is developed, but the tabularia are surrounded by 19 – 20 tubules of varying size; tubules throughout the coenenchyme range from 0.2 to 0.5 mm in diameter. Tabularia separated by 3 – 10 tubules. Septa 12, laminar, apparently without axial spines, reaching about halfway to the axis. There are thin horizontal zones in which the skeleton is slightly thicker; these are about 2 mm thick and 7 – 9 mm apart. The tabulae are 0.6 – 1.1 mm apart, and the diaphragms about 11 in 5 mm.

Remarks

Since the review of Australian Silurian and Devonian heliolitids by Jones and Hill (1940) no other overview of the group has been attempted. There is a clear need for any proper study of the group to be based on extensive material, allowing population studies. Here we simply follow the work of Jones and Hill.

Heliolites daintreei, as conceived by Jones and Hill (1940), is an enormously variable species ranging from the Late Silurian to the Early Devonian, even the four informal "groups" not demonstrating reliable stratigraphic range. The present material, as it appears to lack axial spines on the septa, does not fit comfortably in any of the taxa recognised by them.

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APPENDIX 1.

Mile Road Formation

Definition: The name Mile Road Formation is applied to interbedded fossiliferous siltstone and sandstone, containing blocks of coralline limestone and possibly autochthonous limestone lenses, and silicic tuff, mapped as stratigraphically underlying the Touchwood Formation in the eastern part of the Hastings Block.

Synonymy: The unit was first recognised by Taylor (1984) who termed it the Mile Road Formation. The unit was referred to as the Mile Road beds by Roberts et al. (1995).

Derivation of name: Named from the Mile Road that traverses part of the unit in the Cowarra State Forest (GR 478700 6514700 Grants Head 1:25 000 sheet).

Distribution: The Mile Road Formation is known only from the eastern Hastings Block where it has been recognised in the southern part of a slender wedge bounded by the Cowarra, Sapling Creek and Sancrox faults. It is mapped over an area of about 7 km^2.

Type section: Neither Taylor (1984) nor Roberts et al. (1995) designated a type section although the latter authors specified a type locality on the Cowarra Access Road (GR 479000 6514800 to 478900 6513100, Grants Head 1:25 000 sheet). This locality lies nearly along strike and encompasses only the lower part of the formation. We suggest that the type section be that extending northwest from the Cowarra Access Road at GR 478800 6513800 (base) along a tributary of Sarah Creek to GR 478300 6514300 (top) (Grants Head 1:25 000 sheet).

Stratigraphic relationships: Neither base nor top of the unit is exposed. It is truncated downwards by the Cowarra Fault and is here interpreted as being stratigraphically overlain by the Touchwood Formation 1 – 2 km south of the Oxley Highway.

Thickness: A maximum preserved thickness of between 1500 and 2000 m is estimated based on the mapped width of the unit and the assumption of an overall steep northwest dip and consistent northwest direction of younging.

Content: Medium to thick bedded volcaniclastic siltstone and sandstone of intermediate-silicic provenance, locally bioturbated and/or fossiliferous with crinoids, brachiopods and corals. Widespread breccias/conglomerates with coralline limestone clasts to c. 1 m set in a coarse sandy matrix. Grey hard massive silicic tuff interstratified with epiclastic rocks.

Age and correlation: A small conodont assemblage from probably penecontemporaneously derived allochthonous blocks gives a precise age of the upper part of the lower *varcus* Zone, early Givetian. Significant taxa are *Polygnathus linguiformis klapperi* Clausen et al., 1979, *Polygnathus linguiformis weddigei* Clausen et al., 1979, *Polygnathus hemiansatus* Bultynck, 1987 and *Icriodus difficilis* Ziegler et al., 1976. Additionally the blocks contain an abundant macrofauna of rugose and tabulate corals, spongiomorphs and brachiopods; the branching tabulate coral *Thamnopora*, occurring in the bioturbated matrix, suggests strongly that the blocks are penecontemporaneous, and that the conodont assemblage indicates a real age, at least for that part of the Formation.